







Overview, Vision & Next Steps

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Biomass Guidelines Technical Team

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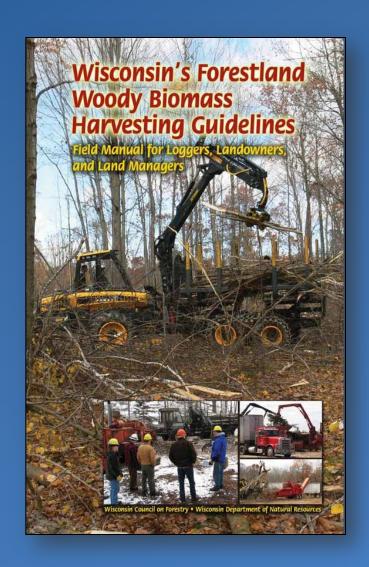


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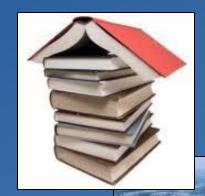
Why Nonforest Biomass Guidelines?

- In advance of widespread development of grass & non-forest biomass industries
- Ensure sustainability & foster improvement of natural resources
- Companion to Forestland
 Woody Biomass Harvesting
 Guidelines



The Approach

- Objectives
 - Science-based
 - Voluntary
 - Public & private lands
 - Uncertainty
 - Big picture
- Intended audiences
 - Biomass producers, agribusinesses
 - Land-owners, land & natural resource managers
 - Policy-makers, community leaders



What is Nonforest Biomass?



Guiding Principles

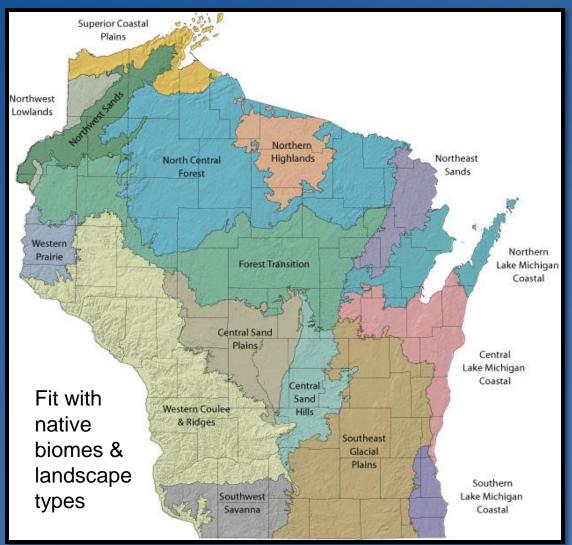
- Maintain & improve:
 - Soil & water quality
 - Fish & wildlife habitat
 - Biodiversity
 - Landscape multifunctionality
- Avoid native habitat conversion
- Compliant with existing BMPs, rules & regulations
- Minimize/mitigate impacts of unknows
- Incorporate socio-economic factors



Sustainability

The stewardship of lands & resources dedicated to nonforest biomass production in ways that are environmentally, socially & economically sound across a broad range of scales; that do not negatively impact other ecosystems; and that meet societal needs now & in the future.

A Sustainable Biomass Landscape?







Uncertainty

- Scientific evidence
 - Credible, abundant & clear
 - Missing, scant, conflicting
- Interpretation
- Precautionary Principle
- Living Document

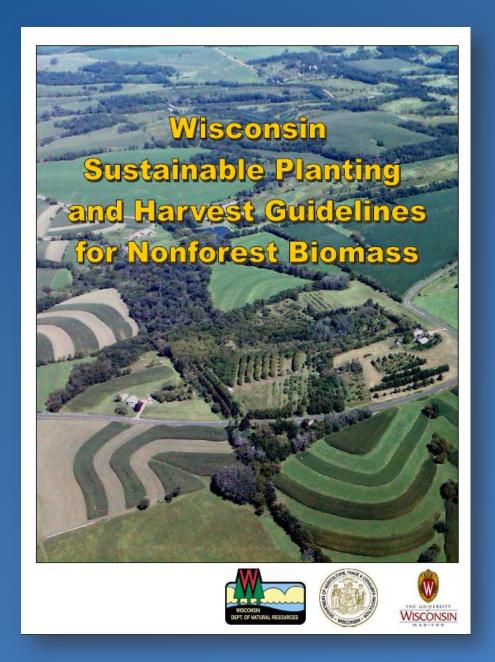


Photo courtesy: Shelley Adelle

Review Process

- Independent science review June 2011
 - 9 independent experts from across the country
 - Were the guidelines sufficiently supported by the science?
 - YES!
- Stakeholder review continuous
 - Wisconsin Bioenergy Council

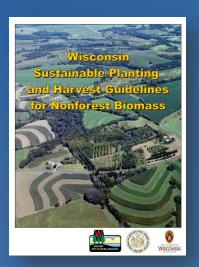
What's Inside?



Document Structure

Chapter 1. Overview & introduction to bioenergy

- Drafting & review processes
- Principles, uncertainty, sustainability, drivers
- Potential biomass resources in Wisconsin

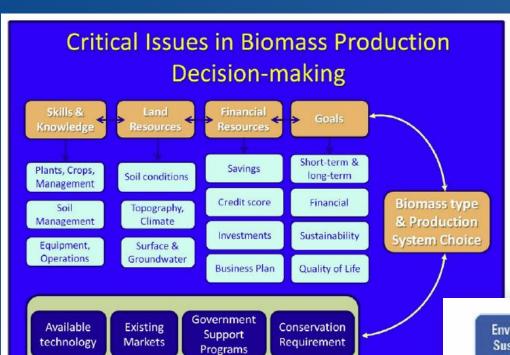


Chapter 2. Considerations for planting & harvest of NFB

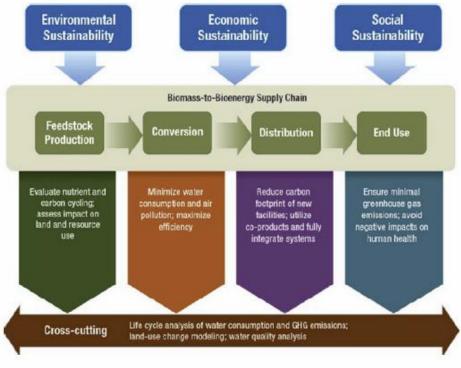
- Benefits & costs, trade-offs, ecosystem services
- •Impacts
- •Socio-economic considerations; decision-making processes
- Issues of scale
- Use of marginal lands

Chapter 3. Voluntary guidelines

Chapter 4. Conclusion & summary

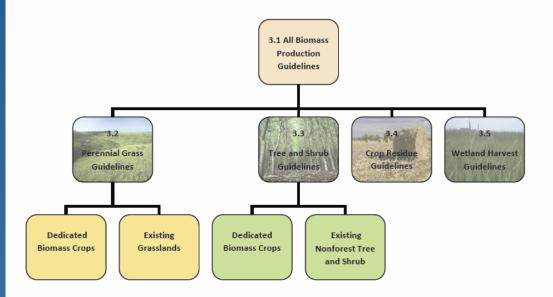


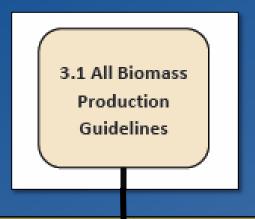
Chapter 2. (detail)



3 GUIDELINES FOR PLANTING, GROWING AND HARVESTING NONFOREST BIOMASS

HOW TO USE THIS CHAPTER: This chapter begins with a set of general guidelines applicable for all non-forest biomass production with references to discussions in chapter 2. These guidelines should be used in making broad decisions about biomass selection. Specific recommendations for planting, managing, and harvesting biomass from grasslands, woodlands, wetlands and row-crop systems follow in the order outlined in the figure below and apply in addition to the general biomass guidelines. Each section is accompanied by a discussion of the science behind and additional resources for each biomass category.





Site selection:

- •Maintain established grasslands, forest & wetlands
- •Carefully match plant selection & management to site conditions
- Keep marginal lands in perennial cover

Crop selection:

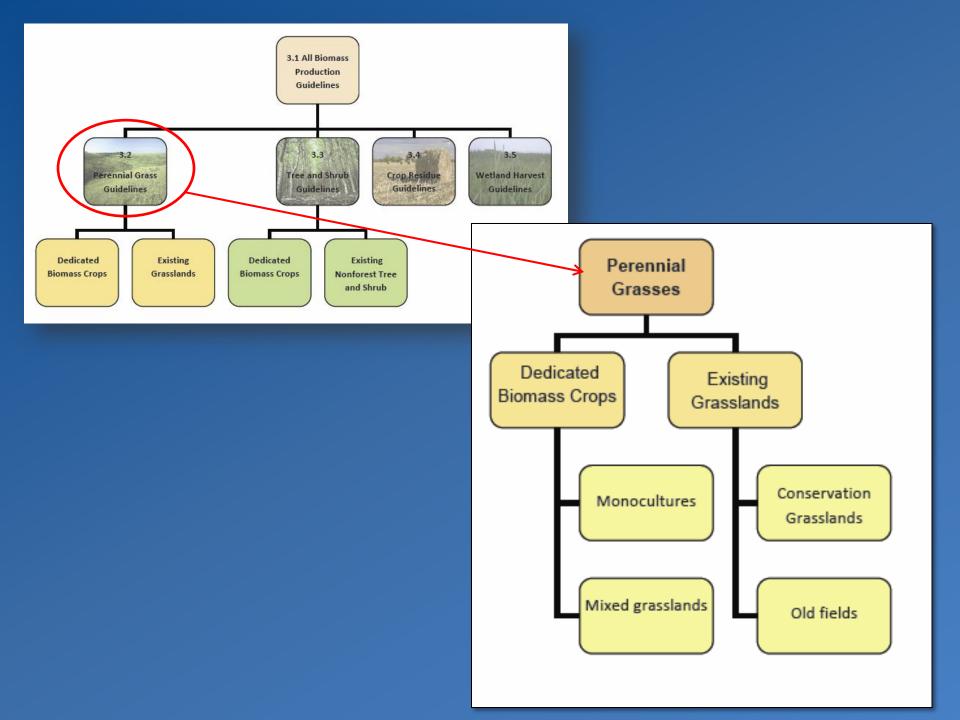
•Plant perennials; use polycultures; avoid use of invasive species

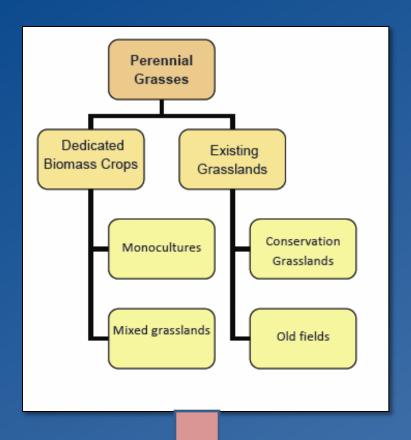
Wildlife:

- Consider context of surrounding landscape
- •Limit management activities to avoid impacts on wildlife species
- •Before planting on uncropped lands determine sensitive resources

Crop management

- •Harvest roads & stream crossings placement to avoid negative impacts
- •Follow existing BMPs
- Practices should conform to conservation plans





Site selection & planting

Weed management

Harvest timing & frequency

Nutrient management

3.2.1.2.5 Diverse Mix Specific Guidelines

Applies to plantings with two or more of the following, warm-season grass, cool season grass, and forbs

- Eliminate noxious weeds and undesirable species. Examples include: leafy spurge, Canada thistle, and wild parsnip (see discussion in <u>section 2.1.2.5</u>).
- Nitrogen fertilizer has no demonstrated benefit on diverse prairie stands, so if possible should be avoided (see discussion in <u>section 3.2.2.2.3</u>).

3.2.1.3 Existing Grasslands

Applies to existing diverse mix grasslands, including prairie and switchgrass mixed stands.

- Minimal or no-till methods are preferred to establish or replenish conservation grasslands on marginal land enrolled in a bioenergy program (if being reinvigorated or replenished-one time tillage may be necessary; see discussion in section 3.2.2.3).
- <u>Consider the no-fertilizer option</u> to maximize environmental benefits; if choosing to fertilize, consider organic fertilizer options (e.g. manure application or legume inter-seeding) before chemical options on conservation grasslands (see discussion in <u>section 3.2.2.3</u>).
- Consider longer harvest rotations (i.e. harvesting every 3 or 5 years) on grasslands that were originally established for wildlife habitat, soil quality or water quality purposes (Exception: if more frequent harvest has been demonstrated to maintain/improve services; (see discussions in section 3.2.2.1.5 and section 3.2.2.3).
- Do not harvest from sites where Federal or state endangered species are known to exist or are discovered during operations. (Exception: if harvest has been demonstrated to maintain/improve habitat for species present, then follow appropriate management guidelines to sustain occurrence or condition; see discussions in section 2.2.1 and section 3.2.2.1.3).
- Landowners with expiring CRP contracts are encouraged to consider enrollment into bioenergy programs to ensure that ecosystem services are maintained
- Weed management will likely need to be intensive if converting an existing grassland to a dedicated bioenergy crop

3.2.2 SCIENCE DISCUSSION

3.2.2.1 All Grasslands

Grasslands are a diverse group of systems and can potentially be an environmentally beneficial biomass crop. The fundamental basis for encouraging use of perennial, native grassland/prairie species for biomass production aside from yield lies in the fact that native plants have extensive root systems that improve the ability of water to infiltrate the soil, withstand wet or erosive conditions, sequester carbon, and provide wild-life habitat. Native prairie plants often have greater biomass below the surface than above and provide effective erosion control, can build up soil nutrients, and take advantage of deeper soil resources (Figure 3-1).

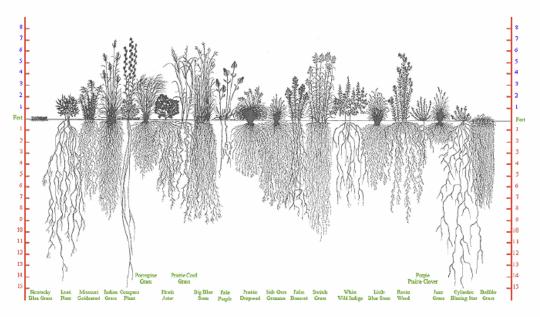


Figure 3-1. Prairie Root Systems. In this illustration, note that the root system of the cool-season grass (Kentucky bluegrass), on the far left, is far shallower then the other native warm-season grasses and forbs depicted. These deep roots allow prairie plants to take advantage of deeper water and nutrient resources. Illustration by Heidi Natura of the Conservation Research Institute

3.2.2.1.1 Harvest Frequency

The guideline of harvesting no more than once per year supports stand longevity and keeps costs down. Switchgrass and other warm-season perennial grasses grown for biomass do not need to be managed as forage crops like alfalfa or cool-season grasses, which are cut more than once per year to maximize yield and quality. Warm-season tall-grass species do not typically display the same response. Most research has shown greater long-term yields with a single switchgrass harvest than with the combined yields of two or

3.2.2.1.4 Biomass Quality and Yield Considerations

The quality of grasses used in biomass energy conversion systems is influenced by the composition of elements in the grass, which change with the seasons. Thus, the timing of harvest can be an important factor in obtaining high quality biomass. Two factors that affect the quality of harvested biomass are chemical composition and moisture content. Elements found in perennial grasses that can be harmful to biomass combustion boilers are potassium, chlorine, magnesium, and phosphorous. Perennial grasses harvested before senescence (spring/summer) possess the highest levels of combustion contaminants, which decrease as harvest is delayed and crops are allowed to senesce (fall/winter) (Adler et al. 2006; Sanderson et al. 2006). Further aboveground contaminants are leached by rain and snow after senescence (Heaton et al. 2009).

Moisture content also can affect the quality of harvested materials for use as biofuel feedstock. Moisture affects the stable storage, stable transportation, and combustion efficiency of harvested materials. If the moisture content of harvested biomass is too high it may need to be dried before processing, creating logistical concerns and increased costs. Moisture content decreases with time after the first frost with the lowest moisture content occurring in early spring (Adler et al. 2006).

Biomass yields from warm-season grasses are highest just before senescence at the R3 to R5 stage of maturity. Yields decline as the grass becomes dormant in fall, generally from August to November with a smaller percentile loss if harvest is delayed overwinter (Adler et al. 2006). Peak yield is traded for improved health and longevity of the stand and soil when harvest is delayed until after senescence.

3.2.2.1.5 Wildlife Considerations

There are more than 50 grassland dependent wildlife Species of Greatest Conservation Need (SGCN) in Wisconsin (WDNR 2005). The habitats and management regimes required to benefit these species are well understood in Wisconsin (Sample and Mossman 1997). A widespread grassland biomass program in Wisconsin could have dramatic positive impacts on grassland wildlife populations similar to the Conservation Reserve Program (NRCS 2009, Meehan et al. 2010, Robertson et al. 2010). However, the local impact of grassland biomass programs on grassland-dependent wildlife species will largely depend on the type of grasses planted, their configuration across the landscape (Sample and Mossman 1997), and the timing and extent of harvesting. Some grassland birds prefer shorter, more sparse vegetation and may respond positively to annually harvested grassland crops. Other bird species prefer taller, denser vegetation and may benefit from tall dense stands of grassland vegetation that are harvested late in the fall or portions of fields that go unharvested and serve as refugia. For example, Roth et al. (2005) found that a variety of grassland bird species utilized harvested switchgrass fields in Wisconsin because of the resulting mosaic of vegetative heights post-harvest. They also found that harvesting switchgrass fields in mid-August changed the grassland bird composition the following nesting year due to the changes in vegetative height and density.

Certain harvest management strategies could benefit grassland wildlife. Roth et al. (2005) suggested that leaving portions of fields unharvested would provide critical habitat for some grassland wildlife preferring taller dense vegetation.

Beneficial insects may also be influenced by the biomass cropping systems. Landis and Werling (2010) predicted that biofuel cropping systems have the potential of altering arthropod communities on the landscape and may alter pollination and pest control services. They concluded that perennial grass systems provide the best opportunity to favor a variety of beneficial arthropods when compared to annual cropping systems.

Includes resources & links to helpful information

A http://dnr.wi.gov/org/land/er/wlist/WI_ET_Laws_List.pdf

M http://dnr.wi.gov/org/land/er/wlist/WI_ET_Laws_List....

SENSITIVE AREAS AND RESOURCES

There are many sensitive geographical areas and resources in Wisconsin that require further consideration when planning biomass production; we highlight a few types here. You should contact your Extension agri-

File Edit Go To Favorites Help

culture officer, the Land Conservation Depart http://dnr.wi.gov/org/land/er/wlist/WI_ET_Laws_List.pdf - Windows Internet Explorer provided by Wisconsin DNR to see if your potential biomass production are tions.

Sensitive areas and resources include:

- Species listed at the federal or state levo http://dnr.wi.gov/org/land/er/wlist/WI_l
- State Special Concess Species and Spe Action Plan (i.e., rare or declining, bu http://dnr.wi.gov/org/land/er/wwap/exp
- Element Occurrences (EO) of Wiscor http://dnr.wi.gov/org/land/er/wlist/
- Habitat Restoration Areas and Major State Wildlife Action Plan, 2005-2015 http://dnr.wi.gov/org/land/er/wwap/imp
- Designated Natural Areas (both state a Plans); http://dnr.wi.gov/org/land/er/sn
- Karst Areas and shallow carbonate bed
- Important watershed areas: lands surr streams, ponds, and wetlands. Consul ment before beginning a biomass prod
- Highly Erodible Lands (see discussion 12:17

Wisconsin

Endangered and Threatened Species

Laws & List

PUBL-ER-001 2004 REV March 2011

Definitions

Wisconsin Endangered Species: Any species whose

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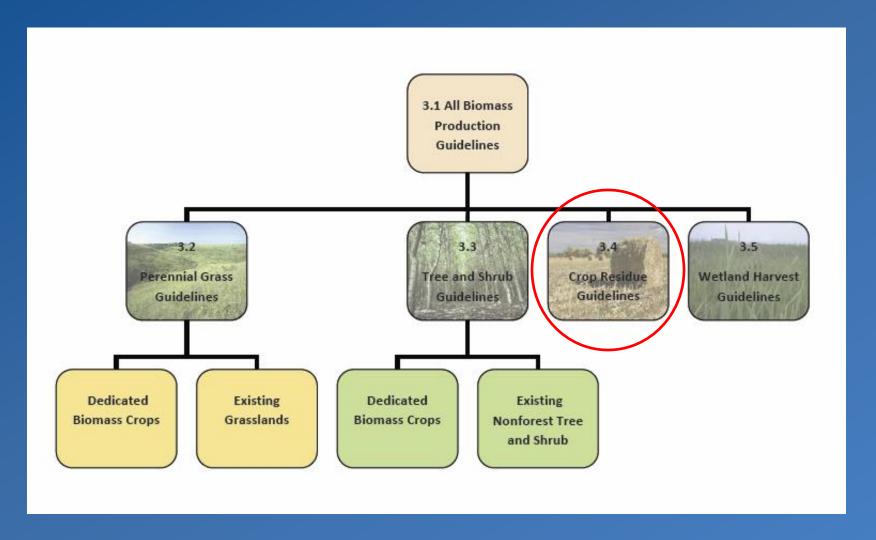
Violations

Endangered and Threatened Animal larria rialatad mintantianaller tha rialata

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Crop Residue Guidelines



Crop Residue

- Guidelines focus primarily on corn stover
- Corn stover harvesting for bioenergy purposes can be part of an overall "multi-functional" landscape
- Additional considerations need to be made to determine amount and frequency of stover

removal

Harvest & Crop Management Issues

3.4.1.2 Harvest

- Only harvest residues when soil loss rate does not exceed "T" and <u>SCI</u> values are greater than zero (see discussions in <u>section 2.2.1.1</u> and <u>section 2.2.1.2</u>).
- Site-specific stubble height, residual cover and stover removal rates should be determined using <u>RUSLE 2</u> and <u>SCI</u> (see discussions in <u>section 3.4.2</u>).
- Without specific field-based assessment (e.g. a conservation plan), remove only 25% of stover to maintain soil organic carbon levels and structural stability (see discussions in <u>section 3.4.2.1</u> and <u>section 3.4.2.2</u>).
- Crop Management: Adhere to conservation plans
 - NRCS 590 nutrient management plan
 - RUSLE2 Conservation plan
 - Soil Conditioning Index

Soil Quality Considerations

- RUSLE2 Conservation Plan
 - Estimates soil erosion rates over a crop rotation based on site specific factors including rainfall, slope, tillage, soil type, crops grown/harvested
- Nutrient Management Plan
 - Managing the amount, source, placement, form, and timing of nutrient applications
- Soil Conditioning Index
 - predicts the consequences of cropping systems
 and tillage practices on organic matter trend

Soil Quality/Productivity Considerations

Nutrients removed in stover

Table 3-2. Average Nutrient Contents for Common Crops (University of Illinois-Urbana extension)

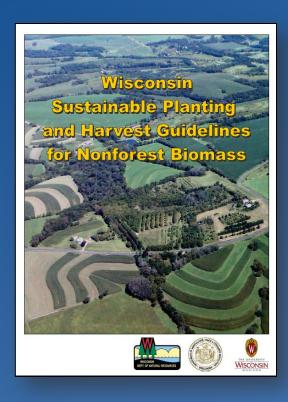
	age Nutrient Content of Corn Stalks (per ton DM)		
	Analysis	Pounds/Ton	Product/Ton
Nitrogen	0.7% N	2000	14.0
Phosphate	0.25% P2O5	2000	5.0
Potash	1.44% K2O	2000	28.8

 Organic matter and/or nutrient deficits can be remedied by manure application

Role of Marginal Lands/HEL Lands

- Marginal lands = less productive for row crops
- Unlikely for bioenergy crop production on prime farmland due to high productivity and commodity prices
- Bioenergy crop production can provide environmental benefits while not competing with food producing acres
- Caution is needed to not add additional stress to low productivity soils (soil mining)

Accomplishments



The *Guidelines* help decision makers with these questions:

- What biomass crop should I grow/harvest?
- Where should I grow or harvest this biomass?
- What information do I need to make sustainable and ecologically sound decisions?

The Guidelines also:

 Provide site level recommendations for sustainable biomass production

Challenges

- Diverse audience
 - Farmers toPolicymakers
- Multiple scales
 - field, fuel-shed,landscape

 Multiple biomass types & cropping systems



Lessons Learned

- No single "biomass" strategy is correct for WI
 - Nor should there be one
- Multifunctional landscapes best for WI
- Diverse, Perennial biomass systems across multiple scales are advantageous
- Policy discussion needed

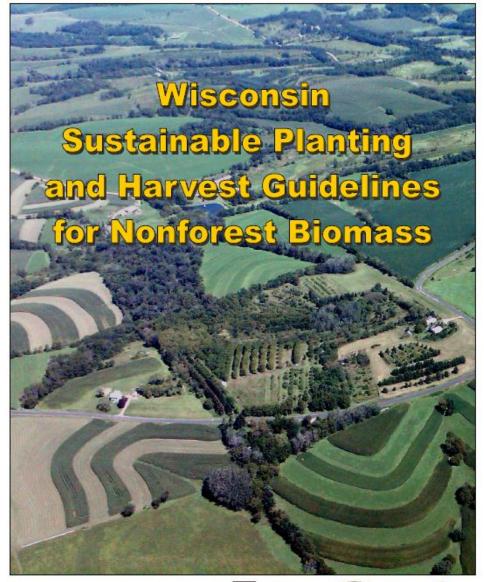


Next Steps

- Jan 1: Printed copies available
- Fall 2011-Spring 2012: Outreach and Extension
 - Collaboration with UW-Extension
 - Extension/outreach plan in development
 - Fact-sheets, technical bulletins, workshops, presentations

The Guidelines

- Wisconsin Bioenergy Council website <u>http://datcp.wi.gov/uploads/About/pdf/WI-NFBGuidelinesFinalOct2011.pdf</u>
- Wisconsin Grasslands Bioenergy Network www.wgbn.wisc.edu









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